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Policy strategies for an emergent technology; lessons from the analysis of EV-policy in 8 North-European countries

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Abstract

This paper presents data from a comparative study of EV-policies in 8 different North-European countries, that maps out all of the policies of these countries (and a range of regions and cities) that target passenger vehicles (PHEV and BEV), chargers (home, private, public; level 1-3), and policies that target the e-mobility eco-system or supporting network, in time-period 2012-2014. The main findings are that 1) there is wide variance of policies put out by the different countries, 2) these policies are hardly part of a coherent policy-strategy, and 3) mainly address the introduction of e-mobility as an issue of "piling up" enough incentives to overcome early market problems (e.g. high costs, reticent customers, slow adaptation of regulation). Most countries we studied were able to meet short-term policy-ambitions, and some have even surpassed those ambitions; Netherlands and Norway for instance are ahead of their targets, both in numbers of vehicles and chargers. However, if we compare the currently applied policies to the medium- and longer term ambitions, these policies are hardly viable. Therefore, argue for alternative policy strategies that do not "pile up" incentives, but look at "mixes" of policies that instigate a self-reinforcing loop in the adoption to EV's.

Keywords: Public Policy, Policy Strategy, Governance, Comparative study, Complexity

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1. Introduction

All over the world, governments attempt to support the transition to e-mobility. The introduction of electric driving is a complex and unpredictable process that is not likely to occur all by itself. The incumbent market structure benefits continuation of regular cars, and consumers are not yet familiar with e-mobility. Furthermore, EV's require a substantial investment by consumers. Due to expensive battery packs sales-price of EVs are higher than those of comparable regular cars. Also, the residual value and life cycle of the batteries is uncertain, as are benefits to be gained from vehicle to Grid applications. All this makes EVs an expensive and risky purchase, even though the total cost of ownership is probably competitive to that of a regular car. Moreover, EVs produce uncertainty for drivers. The limited battery range and the uncertain availability of chargers make "carefree" driving difficult. These are all problems that will eventually be solved, but nonetheless pose barriers to consumer take-up (for an overview of EV barriers see Beeton and Budde, 2013). There is some momentum for EVs, but it remains a fragile and uncertain venture; the emerging market of EV's can still break down.

Governmental action is one of the possibilities to overcome the problems of an emerging market. There is a wide array of *policy-options* available to government to support the introduction of EVs and charging infrastructure. Therefore, governmental intervention requires *choice*; governments wonder which policy to choose, which group or sector to target, what the most effective size and scope of interventions should be, and what timing best accommodates the emerging process of the market. Research into the influence of financial incentives and other socio-economic factors on electric vehicle adoption is currently ongoing (see for instance Sierzchula, et al., 2014), and there is research into particular countries (e.g. Green et al., 2014 on the US and Domingues and Pecorelli-Peres, 2013 for Brazil). Critical studies attack the subsidisation of EVs in the short and medium term with tax-payers money (Prud'homme and Koning, 2012) whilst other authors calculate differently with social / societal lifetime (e.g. public health and atmospheric pollution) costs and come to more favourable results, depending also on the internalisation of the costs by government regulation (Funk and Rabl, 1999). Not only are there many options to choose from, there are also many different theories about what to choose for (see: Van der Steen et al, 2012; Van Deventer et al, 2011: Browne et al, 2012).

Furthermore, some studies reflect on the "best" scale of governance for EV-policy (see e.g. Bakker, 2014; Bakker et al., 2014). For some, and especially in an EU level, the notion of subsidiarity comes in: "the *sharing*, not *shedding*, responsibility in the context of a multi-level policy where the policy process straddles supra-national, national, regional and local levels" (Flynn and Morgan, 2004: 22). Hierarchically, there is the level of global agreements, e.g. through the International Energy Agency (IEA), which can drive innovation, collaboration and dissemination (IEA IA-HEV, 2011, 2012). There is then the level of integrated markets, e.g. with mandatory standards around emissions for vehicles. Then there is the regional (eg. Electric mobility pilot regions), and not least there is the local level which again has extra policies. EV-policy is a multi-level policy game, whereas policy-makers continuously have to take into account and operate within frameworks and actions set elsewhere. Governance is *nested*, which is to say that the UK or German or Dutch national level cannot be seen separate from the EU level (see negotiations in the Council of Ministers and the European parliament over emission standards of vehicles etc), nor can the regional level be seen as disconnected from the national / Federal or international one in terms of investment, competition, standards (including for charging infrastructure), nor can the local one (e.g. air pollution from the EU one). Nested means there is a variance of policy measures for a variety of reasons and motives, and one should learn from each other, whilst being in the same overall framework which influences what one has to address and to some extent the rules of doing so.

There is a growing literature on EV policy at national, and to some extent regional and local level, and now also supra-national level (Bakker, 2013a,b; Kotter, 2013; Loisel et al, 2014). However, only some is of a comparative nature, and other than project reports (e.g. Trip et al., 2012) or commissioned consultancy studies (e.g. E4Tech, 2013). There is comparative

work that contrasts two or three cases; e.g. Calef and Goble (2007), who contrast the approaches of California and France to promote electric and hybrid vehicles. Other examples of two-country comparisons are Yang (2010), Karplas et al. (2010), and Steinhilber et al (2013).
This present paper adds to this literature by exploring the policy-options for governments that want to support the further introduction of EVs, and by doing so from a multi-country case-set. The paper is based on a study that gathered all of the formally documented policies with regards to e-mobility that a selected group of governments put in place in the period between 2012-2014.

Scope, Methods, and Limitations

This research focuses purely on *passenger vehicles*[6] and *multipurpose passenger vehicles*[7]. Furthermore, the present study focuses solely on a specific type of electrified drive trains; of the most commonly used categories - hybrid electric vehicles (HEVs)[8], plug-in hybrid electric vehicles (PHEVs)[9] and battery electric vehicles (BEVs)[10] – we take into consideration only policies concerning *PHEVs* and *BEVs*. Policy for HEVs is not part of the research. Also, we did not look at other possible options for clean mobility, such as bio-fuels, hydrogen, or the substitution of cars for public transport (Van der Steen et al., 2014).

In order to collect the study's data we gathered all the documents they could find for the seven case-countries in this specific study; the Netherlands, Belgium, Germany, Denmark, Sweden, Norway, and the UK. California is added as a comparative case to contrast the European findings. California is widely regarded as a frontrunner in the transition to e-mobility (Plugincars, 2013). To collect the documents a "snowballing"-method was employed to gather more information about policy. Many documents contained references to other studies and sources that we then looked up and included into their model.

The analytical lens we employ is based on, firstly, a value-chain approach to e-mobility (Beeton, 2014), which we here arranged into three chains – with interactions and interdependencies of the electric vehicle, the charging infrastructure, and the (wider) enabling network (the grid, Information and Communications Technologies (ICT) and Intelligent Transport Solutions (ITS) and services etc. Secondly, we adopt Hood and Margetts' (2007) four different categories of tools for government to "steer", and use these four categories as a first lens to organize the policies. In the table below they explain the categories and apply them to policy for EVs. Thirdly, we looked at policy as originating from one of four levels of government; policy is *transnational*, *national*, *regional*, or *local.*

With this first selection of documents we populated our database and ran a first scan of results. For each country, we drafted an analysis of its EV-policies and asked a local resource colleague to take a critical look at the document; they then asked the local colleagues to correct their document and send them links to relevant documents not yet included in the study. We analyzed this second set of documents and improved their country-analysis on the basis of the feedback from the local colleagues. After that, we finalized our findings in a draft-report. During 2013 we kept collecting new documents, in order to be able to keep the database up to date with new policies and new data about performances.

As a third round, we presented and discussed the draft-report in four feedback sessions where expert representatives of the participating countries reflected on their interim findings. Representatives were selected from both the local academic community and the community of EV-policy makers from that country, region, or municipality. In each session, we presented a selection of the findings that were relevant to the particular audience (country). After that, we first asked participants if they

[6] Vehicle with a designated seating capacity of 10 or less (IEA, IA-HEV and AVARE, 2013).
[7] Vehicle with a designated seating capacity of 10 or less that is constructed either on a truck chassis or with special features for occasional off-road operation (IEA, IA-HEV and AVARE, 2013).
[8] HEV has the ability to operate all-electrically, generally at low average speeds. At high steady speeds such a HEV uses only the engine and mechanical drivetrain, with no electric assist. At intermediate average speeds with intermittent loads, both electric and mechanical drives frequently operate together. (IEA, IA-HEV, 2011).
[9] A HEV with a battery pack with a relatively large amount of kWh of storage capability, with an ability to charge the battery by plugging a vehicle cable into the electricity grid. (IEA, IA-HEV, 2011).
[10] An BEV is defined as "any autonomous road vehicle exclusively with an electric drive, and without any on-board electric generation capability". (IEA, IA-HEV, 2011).

recognized or could validate the findings and if they had additions or other (critical) remarks about them. Then, there was time for discussion about the more general implications of the findings and possible implications for policy. Each of the feedback sessions resulted in a general recognition for and support of the authors' findings, but also lead to interesting discussions about methodology and about the dilemmas of policy for EVs.

Outline of this paper

We start with a presentation of the framework used to analyze policies. After that, we present the assorted variety of policies we found. In the discussion section, we reflect on what we think one can learn from these policies for the next phase in the introduction of e-mobility.

2. A framework for analyzing EV-policy

Lens 1: Policy at a certain Level of government

As a first lens for our analysis, we looked at policy as originating from one of three levels of government; policy is *trans-national*, *national*, *regional*, or *local* – with a hierarchy but also interactions between levels and a multi-level governance nature to it, and competition also between countries, regions and cities (c.f Bakker, 2014). Different countries work with different systems, where other levels of government are responsible for e-mobility. The model takes this into account, in order to be able to analyze the differences in various countries. Some organize policy from the local level, while others have a stronger national policy that is only marginally supplemented by local or regional policies.

Lens 2: three Value Chain of E-Mobility

"EV-policy" suggests a coherent and single object and objective for policy. However, if one looks closer, e-mobility involves a variety of related but separate elements. Therefore, we looked at e-mobility as a value chain (Fournier and Stinson, 2011/Squarewise, 2010) where the different segments of the chain can each be targeted by policy. Also, e-mobility can be separated into three different value chains (In 't Veld, 2005); the value chain of *vehicles*, the value chain of *charging*, and the value chain of *surrounding network*. The latter is not so much a chain, but more a third category for policy. For the value chains of vehicles and charging, we see four segments in each chain. Policy can target at least one and possible elements of the chain. For instance, a purchase subsidy targets the vehicles value chain, and within that the consumer-segment. Therefore, we categorize that particular policy as a vehicle-consumer-focused policy in our framework. Figure 1 presents the three value chains; Tables 1 to 3 explain the different segments of the value chains.

Figure 1: Three value chains of e-mobility.

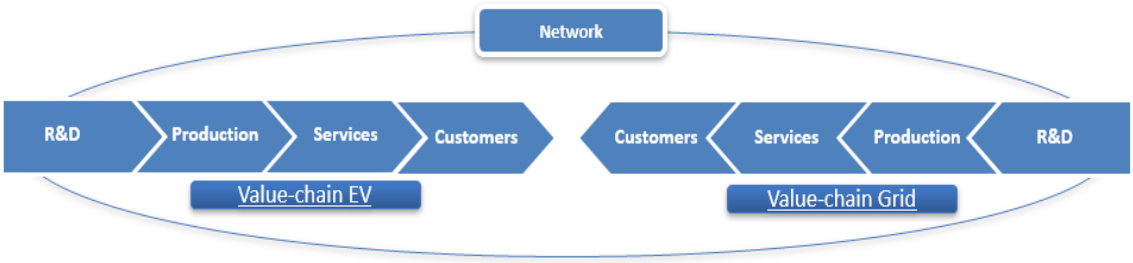

Table 1: Vehicle value chain.

Value chain – electric vehicle	
R&D	• Instruments focused on influencing the research and design of electric vehicles and EV components.
Production	• Instruments focused on influencing the production of electric vehicles and vehicle components such as batteries and other hardware (original equipment manufacturers). This segment of the value-chain also recognizes the software used in electric vehicles.

Services	• Instruments focused on influencing service-providers for electric vehicles. Different service providers are recognized, such as car dealerships, mechanics, insurance companies, etc.
Customers	• Instruments focused on influencing customers of EVs. The study's methodology recognizes individual consumers (end-users), but also fleet-owners (e.g. authorities and leasing companies) and public / governmental agencies (promoting consumerism).

Table 2: Infrastructure value chain.

Value chain – charging infrastructure	
R&D	• Instruments focused on influencing the research and design of the complete charging infrastructure.
Production	• Instruments focused on influencing the production of charging stations and EV system components such as the electricity network, energy production, etc.
Services	• Instruments focused on influencing service providers for charging stations. Different service providers are recognized, such as energy suppliers, power plants, grid managers, software developers, etc.
Customers	• Instruments focused on influencing customers of charging-stations. By 'customers' the study refers both to users (consumers) and owners (consumers, companies, public authorities and government). The different types of charging stations (private, public, fast, quick, normal) require different types of steering by governmental units.

Table 3: Network value-chain.

Value chain – Network	
Network	• These are all of the instruments that focus on connecting stakeholders in the EV / infrastructure value-chain. For instance, efforts intended to intensify contacts between different stakeholders, in order to improve value-chain alignment and a more efficient functioning of the entire value-chain. In addition to the value-chain, this includes other policy measures aimed at the e-mobility ecosystem, which are taken into consideration. For instance, policy measures aimed at realizing Smart Grids, Smart economies and Smart mobility Beeton (2012)[i]

Lens 3: Policy as Tools

In their classic *tools of government*-study Hood and Margetts (2007) distinguish four different categories of tools for government to "steer". We use these four categories as a first lens to organize the policies. In Table 4 below we explain the categories and apply them to policy for EV's.

Table 4: Tools of government.

Tools of government	
Legal	• All of the rules and directives designed to mandate, enable, incentivize, limit or otherwise direct subjects to act according to policy goals. • E.g.: legal requirements, local parking legislation, European legislation for standards for charging-station accessibility, limited access to urban areas or roads.
Financial	• The policy instruments involve either the handing out or taking away of material resources (cash or kind), in order to incentivize or disincentivize behavior by subjects. The difference between financial and legal measures is that those affected are not obliged to take the measures involved, but are incentivized to do so by their own choice. • E.g.: purchase grants, tax benefits for consumers of EVs, government funding for battery research, subsidies on home chargers, or free electricity for public charging.
Communication	• Instruments that influence the value-chain of e-mobility through to the communication of arguments and persuasion, including information and education. • E.g.: education in schools, government information campaigns.
Organization	• Actions by government that provides the physical ability to act directly, using its own forces to achieve policy goals rather than others. This includes the allocation of means, capital, resources, and the physical infrastructure needed to act. • E.g.: government or public authorities acting as a launching customer, buying an own fleet of EVss, government installing public chargers.

3. Findings: an analysis of EV-policies in seven EU countries

In this chapter we compare the variety of policies at different governmental levels in different countries. We present our general findings and illustrate them with examples from different countries. The complete results and the total body of policies can be found in the project background report (Van der Steen et al., 2014a,b).

Finding 1: most NSR countries focus on financial and organizational instruments

The countries in this collated data set primarily focus on financial and organizational instruments (see Table 5). Most policies fall into either one of those two categories of tools.

As for financial instruments, countries adopt very similar policies. They are often conducted by the national government and are mostly fiscal (registrations bonus based on emissions, income tax measures and opportunities for businesses to relieve the cost of an EV against taxable profits). Also, governments apply a considerable number of organizational-instruments (see Table 6 for examples). Especially at the regional and local levels the authors observe a lot of 'organization tools'. Local and regional governments – but also some public-private partnerships - install many local project organizations that, for instance, carry out grant applications and are launching consumer initiatives. This generates extra dynamics to the incentives and benefits set out by the national government.

The focus on legal and communication instruments is limited compared to financial and organizational instruments.

Table 5: Type of policy actions (Van der Steen et al., 2014).

Type of policy actions				
NSR-countries	**Legal**	**Financial**	**Communicative**	**Organizational**
Belgium	-	++	-	+++
Denmark	-	+++	-	++
Germany	-	++	-	+++
Netherlands	-	+++	-	+++
Norway	++	+++	-	++
Sweden	-	++	-	+++
UK	0	++	-	++
Comparative case: California	++	+++	-	-
0 = Limited information found / available - = Limited focus ++ = Strong focus +++ = Prevalent focus area				

Table 6: Examples of organizational tools used in different countries.

Organizational incentives in NSR countries, and California (USA)	
Denmark	**Platform:** • **Information Centre**. In cooperation with the Danish Energy Agency, the Centre for Green Transport has established (Established in2011) an information centre to exchange experiences on EV's between local communities in Denmark (Bakker et al., 2012 / European Commission, 2011 / IEA IA-HEV, 2014) **Project organization:** • **Copenhagen Electric.** Copenhagen Electric focuses on strengthening the capital region's international competitiveness and ensuring greater cooperation in the Øresund Region and other regions in Europe by providing objective information about electric vehicles to municipalities, companies and private individuals. Also projects, campaigns and partnerships on EVs are initiated (Copenhagen Electric, 2014).
Germany	**Project organization:** • **Model regions:** o **E.g. Elektromobilitat Model Region Hamburg.** The testing of diesel hybrid buses on lines; innovative energy storage for rail vehicles; the use and develop-

	ment of EVs and charging infrastructure; the use of EVs in commercial traffic (BMVI Elektromobilitat Model Region, 2014). ○ **E.g. Model region Bremen/Oldenburg.** The model region Bremen/Oldenburg applies a cooperation between partners such as the University of Bremen, Bremer Energie Institut and Centre for Regional and Innovation Economics. The local Daimler/Mercedes production plant use the knowledge to produce new technologies (BMVI Elektromobilitat Model Region, 2014).

Finding 2: Most NSR-countries initiate policy from the national government level

As summarized in Table 7, in most countries most policy is made at the national level. However, with that said, there are often also very active local and regional communities that provide all sorts of activities to stimulate e-mobility. The main body of policy is national – fiscal, regulation – but that is accompanied by local and regional policy that provides a local colouring and fine-tuning.

Table 7: Government level of EV policy (Van der Steen et al., 2014).

Government level			
Country	**National**	**Regional**	**Local**
Belgium	-	+++	-
Denmark	-	+++	+++
Germany	+++	++	-
Netherlands	++	++	++
Norway	+++	-	-
Sweden	+++	-	-
UK	+++	++	-
Comparative case: California	++	++	++
0 = Limited information found / available - = Limited focus ++ = Strong focus +++ = Prevalent focus area			

Finding 3: In most NSR-countries policy focuses on vehicles rather than charging

Policy instruments mostly focus on the vehicle-value chain (see Table 8). Within the EV-value chain, governments primarily focus policy on consumers. Some countries focus more prominently in R&D and in upstream segments of the value chain. Little attention is given to the segment of services, which could be a missing link between the demand of consumers and the supply provided by manufacturers.

Table 8: Policy focus on the vehicle value chain (Van der Steen et al., 2014).

Policy focus in the EV-value chain				
Country	**R& D**	**Production**	**Services**	**Customer**
Belgium	-	-	-	++
Denmark	+++	0	-	++
Germany	+++	++	-	+++
Netherlands	-	++	-	+++
Norway	++	-	-	+++
Sweden	++	-	-	++
UK	++	-	-	++
Comparative case: California	+++	++	-	++
0 = Limited information found / available - = Limited focus ++ = Strong focus +++ = Prevalent focus area				

Finding 4: Policy mostly targets the downstream of the vehicle value chain

Most countries focus their policies downstream in the value chain; they adopt a large number of financial incentives, at different government levels (tax incentives, rebates, subsidies, local benefits, etc.). In Denmark, one-third of the steering instruments in the EV value chain focus on consumers. Different levels of government implement downstream policies. Subsidies and tax incentives are usually implemented at national level. However, local governments also provide financial incentives, often cash but mostly 'in-kind'. Examples are free or preferential parking, access to toll lanes, free charging, free access to ferries for EVs. At first glance, these are small incentives. However, their impact should not be overlooked. In a recent Californian survey 59% of the respondents indicated that access to the high-occupancy vehicle lane (HOV-lane) was extremely or very important in their decision to purchase an EV, making it the most important motivator for purchase found in the survey (CCSE, 2014).

Table 9: Examples of financial instruments for EVs focused downstream in the vehicle value chain (consumer focused).

Examples: Financial incentives - downstream, consumer focused)	
The Nether-lands	**Tax incentives (IEA IA-HEV, 2011):** • EV's are exempt from the registration tax and from the annual road tax. Fuel cell EVs follow the same ruling. • For leased cars, an income tax measure makes EVs and HEVs attractive. A normal tariff of 25% of a leased car's value that is added to the annual income tax is eliminated (7% from 2014) for zero-emission cars (less than 50g CO2/km) or will be 14% or 20% according to the fuel type and CO2 emissions if the cars are fuel-efficient. • Tax relief regulation for purchasing commercial electric vehicles. • Through the MIA and VAMIL regulation of the central government, entrepreneurs can receive a subsidy for purchasing an EV or installing charging infrastructure (RVO NL, 2013). **Rebates / subsidies:** • The city of Amsterdam grants subsidies up to 5.000 Euros to purchase EVs which are being used for business and up to 10.000 Euros for purchasing electric taxis and courier cars (Programma-bureau Luchtkwaliteit, 2010).
Norway	**Tax incentives (WSDOT, 2012 / Bakker et al., 2012):** • EVs are exempt from non-recurring vehicle fees. • EVs are exempt from sales tax. • EVs are exempt from annual road tax. Tax free allowance given for this tax (calculated as NOK/km) i.e. for trips to/from working places and for business trips is considerable higher for EV's. Reduction for companies: 75% for EV and 50% for HEV's. • EV's are exempt from taxation for company car benefit tax from 1 January 2009. • Registration tax is calculated according to weight, motor power and CO2 emissions. The vehicles are classified by groups per CO2 'tax'. EV's are exempt from this tax. • Reduced tax for leasing EVs. **Rebates / subsidies (Bakker et al., 2012):** • **Grants for individuals.** The Norwegian government grants subsidies (approximately €4.000) to individuals who buy an EV or HEV class N1 or M1. • **Grants for companies.** To purchase EV's the funding is 50% of vehicle's price; up to 50% are given to companies. **Local benefits ('non-fiscal incentives') (WSDOT, 2012 / Bakker et al., 2012):** • **Domestic Ferries.** EVs have free use of domestic ferries. • **Free Access.** EVs have free access to public areas. • **Free Parking.** EVs can park for free in public parking places. This measure has been in place since the beginning of the 1990s. • **Toll Roads.** EVs can use the toll roads for free. • **Use of Bus and Taxi lanes.** EVs are permitted in bus and taxi lanes. This measure has been in place since 2003.
Comparative case: **California**	**Tax incentive** • Tax credits for purchasing electric vehicle (between $2,500 & $7,500 per vehicle, depending on battery capacity). **Rebates / subsidies** • A credit equal to 10% of cost up to a maximum of $4,000 is available for kits that will convert a standard vehicle to plug-in EV. • Clean Vehicle Rebate Project offers rebates for the purchase or lease of qualified vehicles. Rebates up to $2,500 per vehicle.

Most countries focus downstream (consumers), but some also work upstream (R&D and production). Most of these instruments are financial (see Table 10 for examples). Germany focuses strongly on R&D in EV policy, which can be explained by the presence of major vehicle manufacturers in Germany. However, Sweden also has a strong focus on R&D. Over one-third of the policy instruments found in Sweden focusses on stimulating R&D. In France, Renault has teamed up with the CEA (French Alternative Energies and Atomic Energy Commission) to work on electric vehicles, new energies and cleaner combustion engines. Compared to the European cases, California is very upstream (mostly R&D) focused (Van der Steen et al, 2014a,b).

Table 10: Examples of upstream financial incentives.

Financial incentives - upstream of the value chain (R&D and production focussed)	
Germany	**Research funding (BMWI, 2014 / Squarewise, 2010)** • The storage battery programme is founded to build capacities in Germany for implementation throughout the whole supply chain in the production of storage batteries. The programme runs from 2009 until 2012, and the Federal government has granted 35 million Euros to this programme. • The third mobility and transport research programme (BMWI) sets out the goals, for instance to research into drive technology. Special importance is attached to developing new vehicle concepts and technologies for reducing energy consumption and pollution by road transport. • Through the BMBF ICT 2020 research for innovation, EENOVA receives 100 million Euros for research on energy management in EV's. • The Lithium-ion battery alliance is a project to substantially increase the energy and performance density of lithium ion batteries and to accelerate the possible use in production. The Federal government has granted 60 million Euros to this project.

Finding 5: Few countries focus on charging infrastructure. Also, policy in the infrastructure value chain focuses less on downstream and targets the upstream segments (production and services).

In the infrastructure value chain, the focus upstream can be explained by the relatively large number of policies that focus on the installation of (semi)-public charging points (mostly by regional and local governments). Many of those instruments focus on the installation of (semi-) public charging points. Studies show that most EV charging currently takes place at home (Snyder et al., 2012). For instance, the UK national government initiated from 2009 onwards the PIP (Plugged-In-Places) programme. It intended to support the development and consumer uptake of ultra-low carbon vehicles by introducing electric-car hubs in six key British cities. Compared to the European cases, California has a lot of rebate/subsidy instruments which focus on the installation of a charging infrastructure. A lot of which are focused on home-chargers.

Table 11 shows the focus in policy for the charging infrastructure value chain. Table 12 (see next page) presents a series of examples of financial incentives that target the downstream of the infrastructure value chain.

Table 11: Policy focus in the infrastructure value chain (Van der Steen et al., 2014).

Policy focus in the charging infrastructure value chain				
Country	**R&D**	**Production**	**Services**	**Customer**
Belgium	0	-	++	++
Denmark	++	-	-	++
Germany	++	++	-	-
Netherlands	-	+++	-	-
Norway	+	++	-	++
Sweden	++	-	-	-
UK	-	++	++	++
Comparative case: California	-	++	-	+++
0 = Limited information found / available - = Limited focus ++ = Strong focus +++ = Prevalent focus area				

Table 12: Examples of financial incentives downstream in the infrastructure value chain.

Financial incentives for charging - downstream of the value chain (consumer focussed)	
Norway	**Local benefits ('non-fiscal incentives'):** • **Free use of Charging Infrastructure.** EV users can use the public charging infrastructure for free (ECN, 2012). • **Grants.** The Norwegian government has granted 11,9 Million Euro for new recharging stations (Bakker et al., 2012).
UK	**PIP (Plugged-In-Places).** Intended to support the development and consumer uptake of ultra-low carbon vehicles by creating electric car hubs in six key British city or city regions or hubs with the installation of charging point in various locations (Bakker et al., 2012 / Kotter and Shaw, 2013).

4. Discussion

The study finds that EV policy captured here mainly targets the vehicle value chain. Also, most countries adopt policies that target the downstream segments of the value-chain, especially consumers. Policy hardly takes into account the segment of services. Within this category of downstream oriented policy, most tools are financial. Especially Denmark, Norway and the Netherlands have strong financial downstream incentives. Three types of financial downstream incentives focusing on EV's are most common: tax incentives, rebates, and specific local extra benefits for EV-owners (e.g. free parking). The Netherlands and Norway both have a high number of tax incentives that make it very attractive for both businesses and consumers to buy or lease EVs. Interestingly, Denmark has similar financial downstream incentives but has so far seen much lower sales and EV penetration in the market. Only a few countries seem to focus explicitly on charging infrastructure. Also, in most cases infrastructure policies focuses more upstream in the value chain (stronger focus on government purchasing and tenders). In the documents the authors studied there was little clear relation between policy directed at vehicles and those focusing on charging. Although the two are evidently sides of the same coin, policy is often made in two separate silos. A more integral policy strategy could improve the performance of policy.

Given the current phase in the introduction of EV's, the emphasis on financial instruments is understandable. The purchase price of an EV and a private charger are high and this will withhold even the early innovators eager to drive an EV from buying one. Downstream financial instruments can overcome these important barriers and have probably been an important factor for the quite successful penetration of EV's in the market; downstream financial policies have been the backbone of the early market phase of EVs. However, if we take into account the exponential growth in the numbers of sales required for the next phase in the introduction, this policy strategy quickly becomes unsustainable. The exponential growth of the next phase of the introduction of EVs requires a self-enforcing loop in the sales of EV, not government policy that is 'pushing' sales by a range of very strong and direct incentives; policy should become more oriented at managing such loops (see: Van der Steen et al, 2013). Already, countries' resources and public support are overstretched and there is societal pressure to downsize financial stimuli. As the quantity of vehicles grows, governments have to look for other tools to stimulate the market for EV's. It is safe to conclude that government policy greatly contributed to the first small but significant steps on the path towards full-scale introduction of e-mobility; however, policy-makers will need a different strategy and different policy tools to further the next step in the introduction. This study displays and reviews the policies made to support the small first steps, now policies have to be developed that support the giant leap.

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